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B. v. BORRIES ET AL
METHOD FOR EXAMINING OBJECTS IN AN AIR SPACE
BY MEANS OF ELECTRON MICROSCOPES
Filed April 12, 1939

2,256,191

FIG. 1.

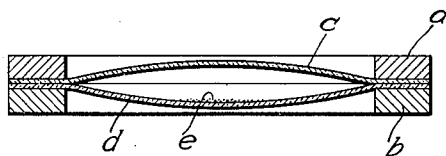


FIG. 2.

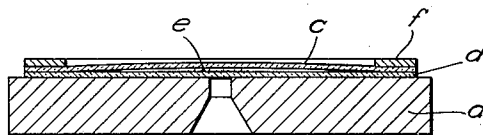


FIG. 3.

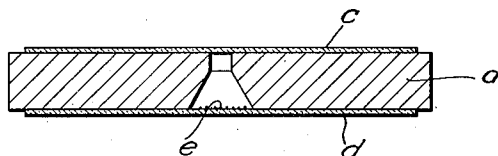
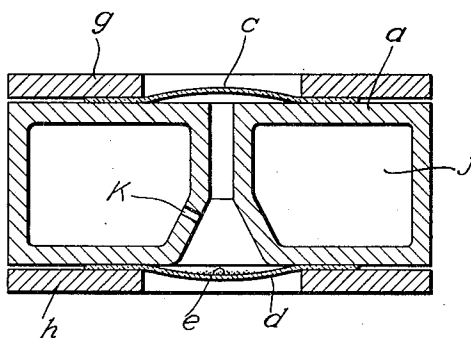


FIG. 4.



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METHOD FOR EXAMINING OBJECTS IN AN
AIR SPACE BY MEANS OF ELECTRON
MICROSCOPES

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to "Fides Gesellschaft für die Verwaltung und
Verwertung von gewerblichen Schutzrechten
mit beschränkter Haftung," Berlin, Germany, a
corporation of Germany

Application April 12, 1939, Serial No. 267,494
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5 Claims. (Cl. 250—51)

The invention relates to a method for examining objects in an air space by means of an electron microscope.

In the case of a magnified projection of objects in so-called electron microscopes it is often necessary to examine the substances in an air space. It has already been proposed to arrange the object to be examined in a space containing air of normal pressure and to close the vacuum chamber of the electron microscope by Lenard windows through which the electron rays pass. Such an arrangement, however, requires a microscope of a particular type which cannot be used when examining objects in vacuum. The known air space microscopes present the further disadvantage that the distance between the object placed in the air space and the inlet or outlet window of the electron rays is relatively large, which incurs a considerable absorption of the cathode rays in the air.

The object of the present invention is to provide means which allow electron-optically examining objects in an air space, particularly with the aid of a magnetic electron microscope, without entailing the above-mentioned drawbacks.

In the magnetic electron microscopes of the known type it is usual to introduce the object into the vacuum chamber of the microscope. In this case the object is, as a rule, carried by a foil secured to a perforated holder or diaphragm. According to the invention, such a holder is provided with two foils forming between each other an air space for the reception of the substances to be examined. The entire holder and air space structure is introduced into the vacuum chamber. The holder may consist of several, for instance two, parts which are secured to one another so as to hermetically seal the space between the two foils. However, a one-piece object diaphragm may also be employed as holder and the foils may be arranged at both sides in front of the diaphragm aperture.

In the accompanying drawing are shown some embodiments of the invention in diagrammatic form.

Fig. 1 shows a cross section of a device according to the present invention having a holding structure composed of two ring-shaped bodies.

Fig. 2 represents a cross section of another example having both foils arranged at the same side of a holding diaphragm.

Fig. 3 represents also in cross section a third embodiment having the foils disposed at both sides of the holder.

Fig. 4, finally, is a section through a device

similar to that of Fig. 3 but provided with an additional air space for purposes described hereinafter.

In Fig. 1 *a* and *b* denote the parts of an object holder in the form of two rings between which are secured the foils *c* and *d* consisting of a material and having a thickness pervious to electron rays. On the lower foil are placed the substances *e* indicated by a number of dots which are to be examined by means of an electron microscope. If such device is introduced into the vacuum chamber of the microscope the foils *c* and *d* are deflected as shown in Fig. 1, due to the expansion of the atmospheric air in the space enclosed by the foils. In this manner an air space containing the substances to be examined is maintained during the observation.

In the embodiment shown in Fig. 2 the foils *c* and *d* are arranged on the upper surface of the holder *a* and are secured thereto by a pressure ring *f*. The substances to be examined are indicated at *e* after the assembled device has been introduced into the vacuum chamber of an electron microscope, the substances *e* remain in an air space.

In the embodiment shown in Fig. 3 the foils *c* and *d* respectively are arranged at the opposite sides of the object holder *a*. In such an arrangement after the device has been introduced into the vacuum chamber, a somewhat greater air volume is available than in the embodiments shown in Figs. 1 and 2, due to the cone-shaped aperture in the holder which in this case is included in the air chamber.

If a considerable time is required for examining the objects or for photographically reproducing their magnified images, it is to be expected that part of the air diffuses through the foils into the vacuum chamber. To prevent the air pressure in the space between the foils from dropping below a permissible limit, an air reservoir may be provided according to the invention, which reservoir communicates with the space between the foils. The volume of the air reservoir is large as compared with the volume of the space between the foils. In this manner the amount of air which disappears by diffusing through the foils is continuously replaced. The container forming the air reservoir is preferably so designed that it may be introduced into the vacuum chamber together with the object holder. The container, for instance, may be associated with the object holder, as is exemplified by the embodiment shown in Fig. 4.

In Fig. 4, *a* represents the object holder proper.

The foils *c* and *d* are secured to the holder by means of rings *g* and *h* and hermetically seal the air space formed by the bore of the holder. The holder *a* contains a chamber *j* which communicates with the bore through a duct *k*. The volume of chamber *j* is considerably larger than that of the air space between the foils *c* and *d* so as to form a reservoir as above-explained.

What is claimed is:

1. A device for examining, in an electron-microscope having an electronic vacuum vessel, objects which must be kept in air, said device comprising an object holder forming a separate body to be exchangeably inserted into the vacuum vessel, said body having an aperture for the passage of electron rays, two foils pervious to electron rays arranged at both sides of said holder respectively and covering said aperture to provide an air space in said aperture, and means for gas-tightly joining said foils with said holder so as to hermetically seal said air space.

2. Means for electron-microscopically examining objects while maintaining them in gas or pressure conditions differing from those of the microscope proper, comprising a diaphragm body to be inserted into the electron-microscope, said body having a bore for the passage of electron rays, two foils pervious to said rays arranged at both sides of said bore and hermetically joined with said diaphragm body, said body having a duct communicating with the interior space of said bore for connecting said interior space with another space of greater volume.

3. A device for examining in an electron-microscope objects which must be kept in air, comprising an object holder to be inserted into the electron microscope, said holder having a bore for the passage of electron rays, two foils

pervious to electron rays arranged at both sides of said bore and hermetically sealed to said holder, a container communicating with said bore and having a large volume as compared with that of said bore, said container being associated with said holder so as to be insertable into the electron-microscope together with said holder.

4. A device for inserting objects to be examined into the vacuum vessel of an electron microscope, comprising an apertured holder to be placed into said vacuum vessel and forming a separate and exchangeable body as regards said vessel, two foils consisting of vacuum-tight material highly pervious to electron rays and being arranged on said holder so as to cover the aperture of said holder and forming between each other an air space for receiving said objects, and sealing means for vacuum-tightly joining said foils with said holder to seal said air space against the vacuum in said vessel.

5. A device for inserting objects to be examined into the vacuum vessel of an electron microscope, comprising an apertured holder to be placed into said vacuum vessel and forming a separate and exchangeable body as regards said vessel, two foils consisting of vacuum-tight material highly pervious to electron rays and being arranged on said holder so as to cover the aperture of said holder and forming between each other an air space for receiving said objects, and a pressure ring mounted on said holder and engaging the peripheral portion of said foils so as to seal said air space against the vacuum in said vessel.

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